

## SYLLABLE STRUCTURE AND SONORITY IN PLAINS SIGN LANGUAGE

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### INTRODUCTION

Sonority organizes phonological strings into syllables. The sonority hierarchy ranks classes of segments (or their features) in terms of relative sonority. In a particular phonological string, a segment higher in sonority than its neighboring segments will be the sonority peak, and it is usually the nucleus of a syllable. Segments between sonority peaks are included in the onset of the following syllable or the coda of the preceding syllable.

Until recently, considerations of sonority were based solely on oral languages. In a 1992 article, Perlmutter sought to show that these same principles of sonority apply to a signed language. He focused on the syllable structure of American Sign Language (ASL). In this paper, we report that the organizational role of sonority is also evident in Plains Sign Language (PSL) syllable structure.

### SYLLABLE STRUCTURE AND SONORITY IN PLAINS SIGN LANGUAGE

The underlying assumption in this and Perlmutter's studies is that Movement (M) and Position (P) are the two basic segment types in signed language. (The basis for this assumption can be found in previous phonological studies of ASL, including work by Liddell 1984 and Liddell and Johnson 1989.) Perlmutter's sonority study examined those types of segment strings containing just one M, or movement. These and Perlmutter's ASL examples are given in Figure 1.1-5.



FIGURE 1 — American Sign Language (ASL) Sign Types  
(After Perlmutter 1992; copyright by David M. Perlmutter and Carol Padden.)

(1) PMP: IMPROVE - "consists of a P (strong hand contact with the weak arm) followed by a movement and another P (strong hand contact with another location on the weak arm)" (Perlmutter 1992:409-410)

(2) MP: SICK - "a movement followed by a P involving contact with the forehead. Since there is no particular location where the strong hand must be prior to its movement, it does not have an initial P" (Perlmutter 1992:410)

(3) PM: TAKE-OFF - "clearly begins with a P since the strong hand makes contact with the weak hand before its movement. Since the strong hand need not be in a particular location at the end of its movement, there is no final P" (Perlmutter 1992:410)

(4) M: FLY - "consists of just a movement; no position of the strong hand is specified either before or after the movement" (Perlmutter 1992:410)

In addition to these four segment string types having just one M, some signs consist of only a P, as in the ASL sign for Germany (Figure 1.5).

(5) P: GERMANY - "the hands remain stationary while the fingers wiggle. Signs consisting of only a P have no path movement." (Perlmutter 1992:410)

We found that these five sign types, on which Perlmutter bases his inquiry into ASL syllable structure, also exist in Plains Sign Language. Examples of these sign types in PSL can be found in Figure 2. In these PSL examples, the letter P is always followed by a subscripted number. The subscript designates the proximity of the position to the signer's body. P<sub>1</sub> designates a position in contact with the signer's body. P<sub>2</sub> represents a position in space near a particular body part of the signer that is necessary to convey the meaning of the sign. P<sub>3</sub> represents a fixed position in space away from the signer's body. We refer to the last two types of positions as spatial positions. In Perlmutter, the only examples of ASL signs having spatial positions are the syllabic P signs, where a P stands alone. The remainder of Perlmutter's examples contain what we refer to as P<sub>1</sub>. Justification for Perlmutter's choice of examples is found in his statement that "Ps articulated at a particular location on the body are most perspicuous." However, many PSL signs provided by our Otoe-Missouria consultant contain spatial positions (Figure 2.1-5).

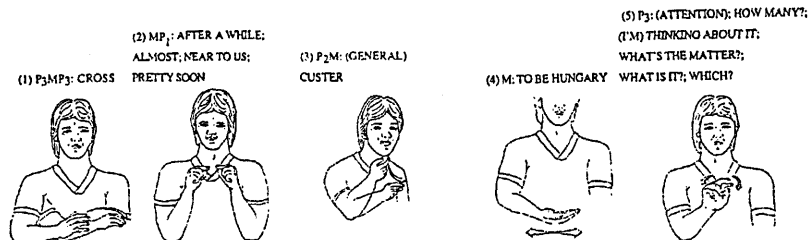


FIGURE 2 — Plains Sign Language (PSL) Sign Types  
(Drawings by David Maddux.)

(1) P<sub>3</sub> MP<sub>3</sub> - CROSS

(2) MP<sub>1</sub> - AFTER A WHILE; ALMOST; NEAR TO US; PRETTY SOON; SOON

(3) P<sub>2</sub>M - (GENERAL) CUSTER

(4) M - TO BE HUNGRY

(5) P<sub>3</sub> - (ATTENTION); HOW MANY?; (I'M) THINKING ABOUT IT; WHAT'S THE MATTER? WHAT IS IT?; WHICH?

Thus, PSL signs reveal the five basic segment string types described by Perlmutter for ASL. But what is the basis for analyzing these five sign types as syllables? In his study, Perlmutter argued that the distribution of two phenomena - secondary movement and handshape change - in the five sign types provides evidence for analyzing these types as syllables.

Perlmutter (1992:411) defined secondary movement as "movement of the fingers or wrist whose key characteristic is that it can occur while the hand executes a path movement," and treated it separately from handshape changes, in which the hands switch from one handshape to another. The two phenomena were distinguished on the basis of their different domains. The domain of the secondary movement was posited as the segment, whereas the handshape features were interpreted as belonging to a prosodic domain, the mora. This difference in domain is not related to the distribution of the two phenomena with respect to Ms and Ps, however, and so is not relevant for the present issue; therefore, we will consider secondary movements and handshape changes together, along with orientation changes, which Perlmutter mentioned only briefly. Hereafter, we refer to these three phenomena as secondary features.

Perlmutter stated that, for ASL, secondary features can occur either on an M or on a P. Some of his examples of these phenomena can be found in Figure 3.1-4.

(1) GO-UP-IN-FLAMES



(2) TAPE



(3) OLD



(4) UNDERSTAND



FIGURE 3 — Secondary Features in American Sign Language  
(After Perlmutter 1992; copyright by David M. Perlmutter and Carol Padden.)

(1) Secondary movement on M: GO-UP-IN-FLAMES - finger wiggling occurs during a path movement

- (2) Secondary movement on P: TAPE - circling while the hands are stationary
- (3) Handshape change on M: OLD - change from an open handshape to a closed handshape during a path movement
- (4) Handshape change on P: UNDERSTAND - change from a closed handshape to an open handshape occurs on a P

In examining those environments that systematically exclude secondary features, Perlmutter demonstrated that, in ASL, an M can always have secondary features, regardless of its environment, whereas a P never supports these features if it is adjacent to an M. He explains the distribution of secondary features in terms of syllable structure and sonority.

Following are the five segment sequences in ASL with segments marked (with "OK" in front of it) to indicate where secondary features are possible and marked (with "\*\*") to indicate where they are not.

[\*]P[OK]M[\*]P  
 [OK]M[\*]P  
 [\*]P[OK]M  
 [OK]M  
 [OK]P

If one replaces Movements with Vowels and Positions with Consonants, these five segment sequences can be analyzed as syllables as in the following:

[\*]C[OK]V[\*]C  
 [OK]V[\*]C  
 [\*]C[OK]V  
 [OK]V  
 [OK]C

The contrast between vowels and consonants is due to their differential ability to function as a syllable nucleus: A vowel in nearly all contexts will be a syllable nucleus, whereas a consonant will be the nucleus of a syllable only if it is not adjacent to a vowel. Thus, the first four segment strings are syllables whose nuclei are vowels, while the fifth string is a syllabic consonant, i.e. a consonant functioning as the syllable nucleus. The generalization governing the distribution of secondary features is then clear: Secondary features can only occur on the nucleus of an ASL syllable.

If the five segment sequences are analyzed as syllables, the contrast between Ms and Ps is also accounted for in terms of their ability to function as the nucleus of a syllable: An M is always a syllable nucleus, whereas a P can be the nucleus of a syllable only if it is not adjacent to an M. Thus the first four segment strings are syllables whose nuclei are Ms. The fifth string is a syllabic P — a P functioning as the syllable nucleus.

This contrast between Ps functioning as syllable nuclei and those in onset or coda position

correlates with their ability to accept secondary features. Why is it true that for ASL an M is always a syllable nucleus, whereas a P can be the nucleus only if it is not adjacent to an M? Perlmutter explained this finding in terms of sonority: Just as vowels are more sonorous than consonants in spoken language, so are Movements more sonorous than Positions in signed language. "The fact that a P can be a syllable nucleus only if not adjacent to an M is then explained in exactly the same way as the fact that in oral languages a consonant can be a syllable nucleus only if not adjacent to a vowel (Perlmutter 1992:419)."

Pelmutter's findings on sonority and syllable structure also obtain for Plains Sign Language.<sup>1</sup> First, some PSL segments do possess secondary features. When we examined PSL signs that had such features, we found the distribution of these features on the Ms and Ps to be patterned. Just as in ASL, secondary features can occur in PSL either on an M or on a P. Figure 4.1-5 shows secondary features associated with an example of each of the five basic segment sequences in PSL.

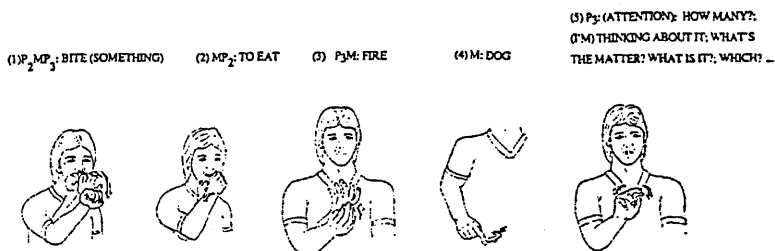


FIGURE 4 — Secondary Features in 5 Syllable Structure Types in PSL  
(Drawings by David Maddux.)

- (1) P<sub>2</sub>MP<sub>3</sub>: BITE (SOMETHING)
- (2) MP<sub>2</sub>: TO EAT
- (3) P<sub>3</sub>M: FIRE
- (4) M: DOG
- (5) P<sub>3</sub>: (ATTENTION); HOW MANY?; (I'M) THINKING ABOUT IT;  
WHAT'S THE MATTER? WHAT IS IT?; WHICH?

In these and all other instances of secondary features, we found that although an M is capable of supporting such features in any environment, a P will only support such features when it is not adjacent to an M. Thus, the distribution of the secondary features in PSL is the same as that in ASL. As in ASL, the differential distribution of these features in PSL signs can be accounted for as follows:

Secondary features can only occur on the nucleus of a syllable.

An M is always a syllable nucleus, whereas a P can be the nucleus only if it is not adjacent to an M, a finding explained by the fact that Ms are more sonorous than Ps.

### A SONORITY HIERARCHY OF POSITIONS IN PLAINS SIGN LANGUAGE

Although Perlmutter dealt only with the relative sonority of Ms (as a group) over Ps (as a group), he suggested that, as understanding of sonority in signed languages increases, it will become clearer whether the various degrees of sonority known in oral languages have analogues in signed language. The Positions of PSL demonstrate such an analogue, as evidenced by the differential distribution of secondary features on the three types of Positions that we distinguished earlier: P<sub>1</sub>, P<sub>2</sub>, and P<sub>3</sub>.

Together, our two consultants provided eight syllabic P signs having either secondary movement, orientation change, or handshape change (our "secondary features"). Of these eight syllabic Ps, six are classed P<sub>3</sub>, that is, a fixed position in distant space away from the signer's body (Figure 5.1-6).

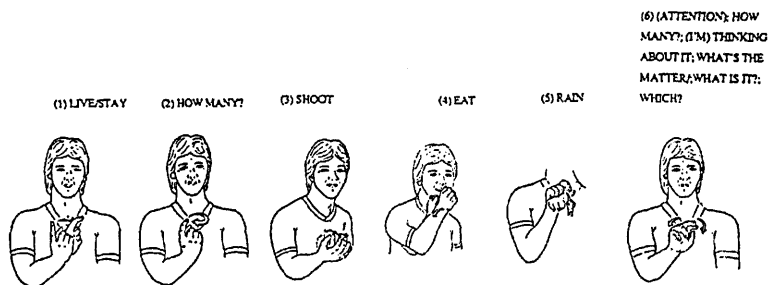


FIGURE 5 — Examples of Syllable P<sub>3</sub> with Secondary Features in PSL  
(Drawings by David Maddux.)

- (1) LIVE/STAY
- (2) HOW MANY
- (3) SHOOT
- (4) EAT
- (5) RAIN
- (6) (ATTENTION); HOW MANY?; (I'M) THINKING ABOUT IT;

## WHAT'S THE MATTER/ WHAT IS IT?; WHICH

The remaining two syllabic P signs are classed as P<sub>2</sub>, that is, each is a position in space near a particular body part of the signer that is necessary to convey the meaning of the sign. These two signs are given in Figure 6.1-2.

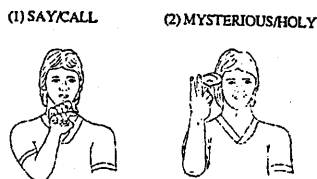


FIGURE 6 — Examples of Syllable P<sub>2</sub> with Secondary Features in PSL  
(Drawings by David Maddux.)

- (1) SAY/CALL  
(2) MYSTERIOUS/HOLY

Thus, in our sample of PSL signs, six of the syllabic Ps with secondary features are P<sub>3</sub> and two are P<sub>2</sub>. The corpus is devoid of instances of these features on a P<sub>1</sub>, that is, a position in contact with the signer's body. The differential distribution of these features on the three P types suggests a relative sonority of Positions. Ms are more sonorous than Ps, and indeed, the environment of occurrence of secondary features on M is unrestricted. On the other hand, the occurrence of these features on P is restricted in just such a way that restriction of occurrence is inversely proportional to the degree of sonority: Thus, P<sub>3</sub> is more sonorous than P<sub>2</sub>, and P<sub>2</sub> is more sonorous than P<sub>1</sub>.

#### M-EPENTHESIS IN AMERICAN SIGN LANGUAGE AND PLAINS SIGN LANGUAGE

The presence of secondary features in PSL P-syllables accords well with Perlmutter's claim that in general "there are no well-formed lexical items in ASL that consist of just a P without either secondary movement or a handshape change or orientation change (1992:434)." There are, however, exceptions to this generalization in both ASL and PSL. In ASL, there are lexical items whose underlying representations violate the generalization and therefore cannot be syllabified, but which undergo phonological rules that make syllabification possible. One class of these in ASL has the following properties, defined by Perlmutter (1992:435): (1) They are realized as MP sequences. (2) Their phonologically distinctive features are not features of the M. (3) No features of the M show up in morphologically related forms. (4) The M can be analyzed as epenthetic. Perlmutter illustrates this use of M-Epenthesis with three categories of signs: the numbers one through nine; the singular pronouns, and a number of lexical signs. These same three categories of

exceptions can also be found in PSL.

In both ASL and PSL, each of the numbers from one through nine has a distinctive handshape and is realized by a short outward movement in "neutral space" in front of the signer, followed by a short hold if the sign occurs in phrase-final position. According to Perlmutter, "the short outward movement seems to be predictable for a significant class of signs articulated in 'neutral space' and can therefore be analyzed as epenthetic (1992:436)." A similar outward movement in PSL numbers can also be considered epenthetic. Thus, both sign systems use M-epenthesis as a "repair strategy" to produce an MP syllable, which enables the underlying P, which otherwise could not be syllabified, to surface as a well-formed syllable.

This analysis can also be applied to the singular pronouns in both ASL and PSL, each of which is composed of a short movement followed by a short hold if it appears in phrase-final position. In both sign systems, orientation is contrastive: the hand (in the G handshape) points toward the signer in the first person singular pronoun, points toward the addressee in the second person, and has a third orientation in the third person. Since the direction of movement in these pronoun forms is predictable from the orientation in ASL and PSL, the M can be analyzed as epenthetic in both sign systems. The singular pronouns of both ASL and PSL have underlying representations that cannot be syllabified but are repaired by M-epenthesis.

This analysis is also viable for a number of ASL lexical signs. One of Perlmutter's examples appears in Figure 7:

LOOK-AT

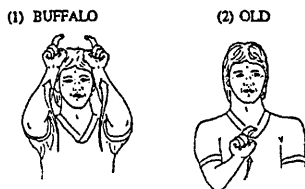


**FIGURE 7 — Example of M-Epenthesis for Repair of a P in ASL**  
(After Perlmutter 1992; copyright by David M. Perlmutter and Carol Padden.)

LOOK-AT "can be analyzed as a P in its underlying representation. M-epenthesis yields an MP syllable: a short movement to a final position (Perlmutter 1992:436)."

Perlmutter determined the epenthetic quality of the M based on the fact that no features of the M segment show up in certain derived forms of LOOK-AT. We were unable to use morphological derivation to show that the movement in certain PSL lexical signs is epenthetic. Nonetheless, this category of exceptions also exists in PSL. Relevant examples from PSL are given in Figure 8.1-2. For these signs, we analyze the M as epenthetic because it is the P segment alone that establishes the iconic nature of the sign:





**FIGURE 8 — Example of Lexical Signs in PSL Repaired by M-Epenthesis**  
(Drawings by David Maddux.)

- (1) BUFFALO  
(2) OLD

Thus, we have found evidence in PSL of the three categories of exceptions to Perlmutter's well-formedness condition for ASL P-syllables. In addition, we have found another significant category of signs in PSL that may be analyzed as underlying Ps repaired by M-epenthesis, the indexical-lexical items. Umiker-Sebeok and Sebeok (1978:xviii) listed four groups of things designated by pointing in their study of aboriginal sign languages of the Americas and Australia. We found examples from all four groups in our analysis of PSL signs.

The first group of indexicals is the personal and demonstrative pronouns. The singular personal pronouns were already discussed as one of Perlmutter's categories of underlying Ps repaired by M-epenthesis. In addition, PSL demonstrative pronouns and demonstrative adjectives should be analyzed as underlying Ps preceded by an Epenthetic M; for example, in the PSL sign for *THAT LAND*, the direction of the movement is determined by the location of the index and can therefore be analyzed as epenthetic. The same analysis can be applied to the other groups of indexicals listed by Umiker-Sebeok and Sebeok. The second group includes the parts of one's own body; a PSL example is *TONGUE*. The third group of indexicals includes colors. In her dissertation on Plains sign-talk, Brenda Farnell (1990:125) states that colors are generally represented by pointing to or touching an item of the relevant color in the immediate vicinity. The fourth group of indexicals listed by Umiker-Sebeok and Sebeok included cardinal directions and regions. According to Farnell (1990:152), "Assiniboiné people always seem to know where the actual cardinal directions lie.... This implicit awareness of geographical direction means that people draw upon a map which is constant regardless of which direction the speaker happens to be facing at the time." During his storytelling performance, the Assiniboiné signer on the video tape we consulted indexed various cardinal directions. An example is *THERE* (index east). The perfunctory and predictable nature of the movement in this sign suggests its epenthetic quality.

For the four groups of indexicals listed by Umiker-Sebeok and Sebeok, PSL signs exist in which the direction of movement is determined by the location of the index and so can be analyzed as epenthetic. Thus, in PSL, indexical-lexical items appear to be a further category of signs that can be regarded as underlying Ps repaired by M-Epenthesis.

## DISCUSSION AND CONCLUSIONS

We have confirmed the existence in PSL of all categories established by Perlmutter for ASL. In addition, we identified a tentative sonority hierarchy of Positions in PSL and added PSL indexicals to the list of exceptions to the well-formedness condition for P-syllables suggested by Perlmutter for ASL. We would suggest a re-examination of ASL material to determine if a similar analysis is viable for the Positions and the indexical-lexical items in that sign system.

We should not be surprised at this suggested sonority hierarchy within the Positions. Previous studies reported similarities between phonetic representations of sound and the featural composition of signs in ASL (Woodward 1974, Friedman 1976); Woodward also reported implicational variation. Examining the four parameters of hand configuration, place of articulation, orientation, and movement, Lane et al. (1976, 1979) replicated for ASL hand configurations an experiment modeled on Miller and Nicely's study (1955) of the perception of English phonemes. Miller and Nicely had found that English consonants were perceived as clusters of features, and that some features were more important in perceptual discrimination than others. In effect, the perceptual reality (or relevance) of some phonological features was judged as stronger than that of others. Lane et al. examined the hand configuration parameter in one experiment, holding place of articulation, orientation, and movement constant; in the second experiment, they systematically varied the other three parameters to see to what extent variations in place of articulation, orientation, or movement would affect the perception of hand configuration. Confusion matrices of stimulus-response pairs (hand configuration presented and hand configuration reported) were prepared and analyzed using clustering, multidimensional scaling, and information measures. From the results, they concluded that just as in the Miller and Nicely results for English consonant sounds, distinguishing features of the signs were found to be confused in a patterned way in the perceptual studies. They prepared a distinctive feature model of hand configurations and concluded that the feature, rather than the sign as an intact entity, was the reality, and further that some features were more important in its description than others.

The active hand functions as the primary articulator in signing. If we compare its role to that of the primary vocal articulators — tongue, lips, glottis — in the production of classes of sounds, we find an arresting parallel. The least sonorant consonants — the stops — are produced by complete contact of the primary articulator on the point of articulation in the vocal tract, just as the active hand — the primary articulator of a signed language — makes complete contact with the body — the point of articulation — in the least sonorant P<sub>1</sub> Positions. Further, neither P<sub>1</sub>s nor stops can be syllable nuclei. The most sonorant consonants, the resonants, demonstrate the least closure of the primary articulator and are parallel to the P<sub>3</sub> Positions that are articulated farthest off the body. Resonants and P<sub>3</sub>s are the most likely to be syllabic nuclei. Using the test of acceptance of secondary features by a Position, we found 6 of the 8 Positions so identified as syllabic were P<sub>3</sub>s. Two were P<sub>2</sub>s. P<sub>2</sub> Positions — like fricatives — are median in both their degree of closeness of the primary articulator to the point of articulation and in their likelihood of being syllabic. The motions involved are the same whether involving vocal articulators or what we might call visual articulators. Indeed, so strong does this action-motion parallel appear to be, between the vocal and the visual production systems, we would further suggest that one should perhaps reconsider the emphasis in phonetics on the air column and its modification acoustically and think

instead primarily of the vocal gestures. It may be that the gestures of point and manner of articulation for signed and spoken languages are the same. The modification of the air column — the sound itself — has always appeared to be the prime in linguistic analysis. In fact, sound may be an emergent property of the motions of the articulator. The motions of the articulator may be the true primes, which are simply seen more directly in signed language than in spoken. In that sense, all spoken languages are signed languages.

#### FOOTNOTES

This work was supported by a Research Experiences for Undergraduates Supplementary Grant to NSF Grant # SBR 9021337 Documenting the Chiwere (Siouan) Language.

<sup>1</sup> We based our analysis of PSL signs primarily on Furbee's videotaped sessions with one Otoe-Missouria consultant, Dr. Truman W. Dailey, who delivered most of his signs in citation form. After our extensive study of the tape, Maddux re-interviewed Dr. Dailey. We augmented the Otoe-Missouria materials with a videotape of an Assiniboiner signer, who made signs as part of a Nakota storytelling performance. The second tape was provided by Dr. Brenda Farnell; we acknowledge her considerable help with gratitude.

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